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iter marginata, haud stipitata, disco coeruleo-livido, extus sericeo-villosa usque ad marginem, fuscidule cinerea, pilis simplicibus, rectis vel subcurvatis, interdum conglutinatis, obtusis, glabris, septatis, 500μ long., usque ad apicem aequaliter 5-7μ lat., subhyalinis, fragilibus obtecta, 0.5-5 cm. diam., 0.5-2 cm. alt. Hymenium plane involutum!

Volcano Atitlán, alt. 2700 m. Dept. Solalá, Guatemala, 16 Feb. 1906, leg. W. A. Kellerman, no. 6204.

Peziza pulcherrima, hymenio plane carens, secundum formam et excipulum hirsutum forsitan Neotiellae Cooke species. Cfr. Sacc. Syll. VIII, p. 190. Similis videtur Lachnea Plumiera Tr. (Sacc. Syll. VIII, p. 170) Americae cent.

——————? On Cactus (Opuntia), Laguna (Lake Amatitlán), Dept. Amatitlán, alt. 1200 m., 8 Feb. 1905, leg. W. A. Kellerman, no. 6225.

"Asci 40-46 x 25-32μ, sporae 20-22 x 8μ hyalinae."

Aegre fero, me plurimis microscopicis praeparatis intra excipula crasse tunicata modo ascos dispersos ovales sporas plane involutas includentes invenisse. Constructio Ascomycetis suspicari licet ad Myriangiaceas pertinentem, haud Pyrenomycetem.

# CULTURES OF UREDINEAE IN 1907.[1]

BY J. C. ARTHUR.

The present article forms the eighth of a series of reports[2] by the author upon the culture of plant rusts, covering the years 1899 to the close of 1907. The grass and sedge rusts form a prominent part of the year's work, the same as in previous seasons, but it has been possible to include also some very interesting studies of a number of species of Gymnosporangium. This was chiefly brought about by two excursions made by my colleague, Mr. F. D. Kern, and myself for the express purpose of securing this sort of culture material, and for making observations regarding probable alternate hosts. The first trip was to Lake Forest, Ill., on April 6, where we secured *G. clavipes*, *G. clavariaeforme* and *G. nidus-avis* in the locality where the last two were obtained by Dr. R. A. Harper for the distribution in Ellis & Everhart's North American Fungi and Fungi Columbiani. Explicit directions were given us by Dr. Harper to enable us to go to the right spots. The second trip was to Colorado where collections were made April 27 at Boulder, May 1 at Glenwood Springs and May 2 at Wolcott. Unusual success attended this search for material, due in large part to the solicitous assistance of Mr. E. Bethel, of Denver, President of the Colorado Academy of Science, who accompanied us to Boulder, and gave detailed directions for finding infested trees at the other places. Mr. Bethel's intimate knowledge of the localities, and his own extensive observations upon these and other rusts of Colorado, all being placed at our disposal, made the few days of our stay in the state remarkably rich in results. The species of Gymnosporangium and Roestelia obtained upon this trip were found upon subsequent study to be in part quite distinct from the well known species to which they have heretofore been referred, and in part entirely new discoveries. These forms have recently been named and characterized by Mr. Kern,[3] and two of the species, *G. Betheli* and *G. inconspicuum*, have been successfully cultivated.

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[1] Read before the Botanical Society of America at the Chicago meeting, December, 1907.

[2] See Bot. Gaz. *29*:268-276, *35*:10-23; Jour. Myc. *8*:51-56, *10*:8-21, *11*:50-67, *12*:11-27 and *13*:189-205.

For the third time the Botanical Society of America generously made a grant to forward this series of studies. This year it was sufficient to pay in large part for the assistance needed in testing the viability of spores, making the sowings, and recording the results, the balance being supplied by the Indiana Experiment Station.

The work was done by Mr. Frank Vasku, a senior student of the University of Iowa, recommended by Professor T. H. MacBride. Like the two previous men from the Botanical Department of the University of Iowa, who have assisted in this work, Mr. Fred. J. Seaver in 1903 and Mr. F. D. Kern in 1904, Mr. Vasku showed exceptional skill in conducting this class of work. His quick understanding of the problems, careful and accurate manipulation, and untiring devotion, were large factors in determining the amount and value of the season's results. Most of the sowings of Gymnosporangium spores were made by Mr. Kern, who took an especial interest in this part of the work, as it bore upon the subject of a thesis in preparation for the master's degree.

In order to study as many species as possible from a wide range of localities, and in this way to investigate the North American rust flora as a whole, it is necessary to depend upon the good will and generosity of contributors for much of the culture material and for hints regarding probable alternation of hosts. Those who have aided the work this year are Rev. J. M. Bates, Red Cloud, Neb., leading with 30 collections of culture material, and Messrs. E. Bethel, Denver, Colo., W. A. Kellerman, Columbus, Ohio, J. Dearness, London, Ont., C. W. Edgerton, Ithaca, N. Y., A. O. Garrett, Salt Lake City, Utah, H.

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[3] Bulletin Torrey Club *34*:459-463. 1907.

D. House, Clemson College, S. C., J. J. Davis, Racine, Wis., T. D. A. Cockerell, Boulder, Colo., D. Reddick, Ithaca, N. Y., R. J. Pool, Lincoln, Neb., E. W. Olive, Madison, Wis., F. L. Stevens, West Raleigh, N. C., C. F. Baker, Santiago de la Vegas, Cuba, and Geo. W. Carver, Tuskegee, Ala. Host plants suitable to grow in pots and be used for inoculation were contributed by C. S. Sargent, Jamaica Plains, Mass., E. Bethel, Denver, Colo., and J. J. Davis, Racine, Wis. For these favors, and for the hearty co-operation of the above and other correspondents most grateful acknowledgment is here extended.

During the present season 98 collections of material with resting spores and 20 collections with active spores were employed, from which 438 drop cultures were made to test the germinating condition of the spores. Out of the 98 collections with resting spores 29 could not be brought to germination, although seemingly in perfectly healthy condition. This left 68 collections of available material, with which the cultures were made. These 68 collections belonged to 47 species of rusts, a considerable part, however, being forms whose life cycle had already been ascertained, the sowings being made for purposes of verification or extending the range of hosts. Beside these collections of resting spores sowings were made of nine species of Gymnosporangium, and of a few species of Coleosporium, Aecidium and Peridermium. Altogether 296 sowings were made, employing for the purpose 113 species of hosts, and more than two and a half times that number of individual plants, all grown temporarily in pots, so that the work could be done in the greenhouse under perfect control. In a few cases where small potted plants were not available cuttings were used, being kept alive by frequently changing the water in which they were thrust, and successively cutting off a bit of the stem to give fresh absorbing surface. The results of this work are given in the following paragraphs, and are divided into negative results, positive results with species whose life cycles have already been ascertained by the writer or other investigators, and positive results with species whose life cycles are now first placed on record.

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Of the trials giving negative results the following may be recorded to serve for reference in future studies:

1. Puccinia on *Carex Pennsylvanica* Lam., collected at Sargent, Neb., by Rev. J. M. Bates, was sown on *Aesculus glabra, Napaea dioica,* and *Symphoricarpus racemosus.* Another collection made near Lafayette, Ind., by Mr. Frank Vasku, was sown on *Anemonella thalictroides, Ranunculus septentrionalis, Solidago Canadensis, Viola striata,* and *Trillium recurvatum.*

Still a third collection made at Boulder, Colo., by the writer, was sown on *Hydrophyllum capitatum, Lactuca Canadensis, Iris versicolor, Phryma leptostachya, Artemisia serrata,* and *A. dracunculoides.* None of these sowings gave infection. Similar material had been tried on five of these hosts before, and on twenty-nine other species, all with negative results.[4] The rust on this host is common in the northern states east of the Rocky mountains, and appears from its morphological characters to be distinct from any described form. Fifty-five sowings have now been made, beginning in 1903, using forty-three species of hosts, and as no innoculation has been effected, the necessity for careful field observations to detect the probable alternate host becomes highly imperative in order to determine the real life cycle.

2. PUCCINIA on *Carex gravida* Bailey, sent twice by Rev. J. M. Bates, first from St. Paul, Neb., was sown on *Aesculus glabra, Viola cucullata, Ribes Cynosbati,* and *Hydrophyllum Virginicum,* and second from Red Cloud, Neb., was sown on *Hypoxis erecta, Houstonia purpurea, Laciniaria spicata, Lactuca Canadensis,* and *Artemisia dracunculoides,* with no infection. Similar material from the same region has been sown in previous years upon thirty-four other species of hosts with negative results.[5]

3. PUCCINIA on *Carex Douglasii* Boott. collected at Valentine, Neb., by Rev. J. M. Bates, was sown on *Symphoricarpus racemosus, Napaea dioica, Psoralea Onobrychis, Aesculus glabra, Laciniaria spicata, Hypoxis erecta,* and *Flacata comosa,* with no infection.

4. PUCCINIA ELLISIANA Thuem., on *Andropogon scoparius* Michx., collected at Boulder, Colo., by Mr. E. Bethel, was sown on *Arabis* sp., *Thalictrum dioicum, Actaea alba, Psoralea Onobrychis, Polygala Senega, Viola striata, Polemonium reptans, Solidago Canadensis, Boltonia asteroides, Senecio obovatus, Lepachys pinnata,* and *Smilacina stellata,* with no infection.

5. PUCCINIA VIRGATA Ellis & Ev., on *Chrysopogon avenaceus* (Michx.) Benth., collected at Grand Island, Neb., by Rev. J. M. Bates, was sown on *Ceanothus Americana, Napaea dioica, Caulophyllum thalictroides,* and *Cassia Chamaecrista,* with no infection.

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[4] See Jour. Myc. *10*:10. 1904; *11*:51. 1905; *12*:12. 1906; and *13*:191. 1907.

[5] See Jour. Myc. *10*:10. 1904 *11*:52. 1905; and *13*:191. 1907.

6. Puccinia emaculata Schw., on *Panicum capillare* L., collected in the vicinity of Lafayette, Ind., by Mr. F. D. Kern, was sown on *Psoralea Onobrychis, Viola cucullata,* and *Myosotis palustris,* with no infection. This rust was sown in previous seasons on twenty other species of hosts.[6]

7. Puccinia Arundinariae Schw., on *Arundinaria macrosperma* Michx., collected at Clemson College, S. C., by Mr. H. D. House, was sown on *Myrica cerifera, Ilex opaca, Smilax hispida,* and *Lysimachia quadrifolia,* with no infection.

8. Puccinia Schedonnardi K. & S., on *Schedonnardus paniculatus* (Nutt.) Trel., collected at Boulder, Colo., by Mr. E. Bethel, was sown on *Napaea dioica, Sorbus Americana, Xanthoxylum Americanum, Falcata comosa, Triosteum perfoliatum, Laciniaria spicata,* and *Aster paniculatus,* with no infection. Like material was sown in previous seasons on eleven other species of hosts.[7]

9. Puccinia on *Muhlenbergia tenuiflora* (Willd.) B. S. P., collected at Red Cloud, Neb., by Rev. J. M. Bates, was sown on *Aesculus glabra, Lepachys pinnata, Napaea dioica, Hibiscus Moscheutos, Symphoricarpos racemosus,* with no infection.

10. Puccinia Crandallii Pam. & Hume, on *Festuca confinis* Vasey, collected at Boulder, Colo., by Mr. E. Bethel, was sown on Draba Caroliniana Bursa Bursa-pastoris, *Cardamine bulbosa, Hydrophyllum Virginicum, Mertensia Virginica,* and *Cassia Chamaecrista,* with no infection.

11. Puccinia Montanensis Ellis, on *Elymus condensatus*-Presl., collected at Glenwood Springs, Colo., by Mr. F. D. Kern and the writer, was sown on Delphinium tricorne three times, with no infection. This material was found intermixed with plants of *Delphinium,* species undetermined, but not *D. tricorne,* which exhibited a very abundant development of *Aecidium Delphinii* Barth., and it was assumed that the two forms were alternates. Although the relationship was not established by the attempted culture, yet it cannot be said to be absolutely disproved, as the species of *Delphinium* on which the *Aecidium* occurred was not used.

Another collection of apparently the same species of rust found on *Elymus brachystachys* Scribn. & Ball, at Eldorado Springs, Colo., by the same collectors, was sown on *Delphinium tricorne,* with no infection.

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[6] See Bot. Gaz. *35*:12. 1903; Jour. Myc. *8*:52. 1902; *10*:10. 1904; *12*:12. 1906; and *13*:192. 1907.

[7] See Bot. Gaz. *35*:11. 1903 and Jour. Myc. *13*:192. 1907.

12. PUCCINIA on *Poa longiligula* Scribn. & Will., collected at Boulder, Colo., by Mr. E. Bethel, was sown twice on *Arabis* sp., with no infection. This rust was found so closely associated with aecia of a species of Arabis, that it seemed almost certainly to be genetically connected. Healthy plants of apparently the same species of Arabis were secured from Colorado, and sowings made, the spores giving strong germination, but without positive results. The grass host was determined by Mr. P. L. Ricker of the U. S. Department of Agriculture.

13. PUCCINIA on *Eriocoma cuspidata* Nutt. (*Oryzopsis cuspidata Benth.*), collected at Glenwood Springs, Colo., by Mr. F. D. Kern and the writer, was sown on *Phacelia bipinnatifida, Hypoxis erecta, Symphoricarpos racemosus, Mertensia* sp (from Colorado), *Triosteum perfoliatum, Aquilegia coerulea, Thalictrum polygamum, Amelanchier Canadensis, Hydrophyllum Virginicum, Solidago Canadensis, Laciniaria spicata, Ranunculus recurvatus, Cassia Chamaecrista,* and *Psoralea Onobrychis,* with no infection.

14. PUCCINIA on *Agropyron repens* (L.) Beauv., collected in Kenosha county, Wis., by Dr. J. J. Davis, was sown on *Polymnia Canadensis* and *Hydrophyllum Virginicum,* with no infection. This is a leaf rust having close resemblance to *Puccinia rubigo-vera* on cereals.

15. UROMYCES RHYNCOSPORAE Ellis, on *Rynchospora alba* (L.) Vahl., collected at London, Ont., by Mr. J. Dearness, was sown on *Menyanthes trifoliata* and *Decodon verticillatus,* with no infection.

16. UROMYCES JUNCI (Desm.) Tul., on *Juncus Balticus* Willd., collected at Scotia, Neb., by Rev. J. M. Bates, was sown on *Aesculus glabra, Symphoricarpos racemosus, Napaea dioica, Silphium perfoliatum, Ranunculus recurvatus, Psoralea Onobrychis, Polygala Senega, Viola cucullata, Apocynum cannabinum, Polemonium reptans, Ambrosia trifida, Senecio obovatus, Dirca palustris, Decodon verticillatus,* and *Bidens frondosa,* with no infection. This rust appears to be morphologically identical with the European *Uromyces Junci,* which has aecia upon *Pulicaria dysinterica,* a host that was not at hand when sowings were being made. It is clearly distinct from the rust on *Juncus tenuis, Uromyces Silphii* (Syd.) Arth., not only on account of its structure, but because it refuses to grow on *Silphium.*

17. UROMYCES OROBI (Pers.) Lev., on *Lathyrus decapetalus* Pursh, collected at Boulder, Colo., by Prof. T. D. A. Cockerell, was sown on *Lathyrus palustris* and *Euphorbia Arkansana Coloradensis,* with no infection. This rust is believed to be an autoecious species, and the failure to infect *Lathyrus* is not readily explained.

The following species of rusts were successfully grown, and the data supplement that obtained from previous cultures of this series, or that recorded by other American or European investigators. The results with *Gymnosporangium* are the most considerable since the work done by Dr. Roland Thaxter, concluded at the Connecticut Experiment Station in 1890.

1. PUCCINIA ALBIPERIDIA Arth.—Teliosporic material on *Carex crinita* Lam., collected in the vicinity of Lafayette, Ind., by Mr. F. D. Kern, was sown on two plants of *Ribes Cynosbati* on April 16, giving rise to pycnia April 25, and aecia May 6 in one case, and in the other to pycnia April 29, and aecia May 14.[8]

2. PUCCINIA CARICIS-ASTERIS Arth.—Teliosporic material on a narrow leaved *Carex,* collected at Ithaca, N. Y. by Mr. C. W. Edgerton, was sown May 8 on *Aster paniculatus, Iris versicolor, Ribes Cynosbati,* and *Solidago Canadensis,* with infection only on the first named host, showing pycnia May 16, and aecia May 24. The collection was made adjacent to a clump of *Iris versicolor,* covered with aecia, and there was a possibility of genetic connection, which the culture dispels.

The 24th fascicle of Fungi Columbiani contained a specimen (No. 2366) of *Carex* rust labelled *Puccinia tenuistipes* Rostr., and collected as late as November, 1906, at London, Ont. As this species of rust has its aecia on *Centaurea Jacea,* according to a culture made by Schröter in 1885, and as that host is only occasionally found in North America along the seacoast, and no aecia having been seen on it in these localities,I wrote to Mr. J. Dearness, the collector, for further information and material. He most kindly secured viable material for me from the identical locality. This was sown May 15 on *Ribes Cynosbati, Aster cordifolius,* and *Solidago Canadensis,* with no infection. It was sown again May 25 on *Aster cordifolius* and *Erigeron annuus,* this time with the production of a few pycnia by June 10 on the Aster, but without formation of aecia. Still a third essay was made by sowing June 5 on *Aster paniculatus,* followed by an abundance of pycnia June 12, and aecia June 19, thus establishing the identity of the rust.

In visiting the locality in the spring of 1907, Mr. Dearness discovered that the host is not *Carex varia,* as published, but *C, rosea* Schk., and he has forwarded ample material to verify the determination.

In justification for the use of the name applied to the rust, Mr. Dearness writes, under date of June 22, 1907, that a collection was sent to the late Mr. J. B. Ellis in September, 1889, who thought it might be a new species and drew up a description. Not long afterward Mr. Ellis sent his notes and material to Dr. Rostrup, of Copenhagen, Denmark, who pronounced it to be *P. tenuistipes* Rostr., by which name it has since been called.[9]

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[8] For previous cultures see Jour. Myc. *8*:53. 1902; *10*:11. 1904; *11*:58. 1905; *12*:14. 1906; *13*:196. 1907.

3. PUCCINIA CARICIS (Schum.) Reb.—Teliosporic material on *Carex stipata* Muhl. from the vicinity of Lafayette, Ind., brought in by Mr. Frank Vasku, was sown on *Urtica gracilis* April 19, giving rise to pycnia April 27, and aecia May 2; while a similar collection brought in by Mr. F. D. Kern, and sown April 20, gave rise to pycnia April 27, and aecia May 1.

Teliosporic material on *Carex riparia* Curt., collected in November, 1906, at Scotia Junction, Neb., by Rev. J. M. Bates, was sown April 13, on *Ribes floridum* and *R. rubrum*, with no infection. Another sowing was made April 19 on *Urtica gracilis*, giving rise to abundant pycnia April 26, and aecia May 1. A second collection from the same region, taken in March, 1907, was sown April 4 on *Ribes floridum*, with no infection; and again April 19, on *Urtica gracilis*, giving rise, as in the former case, to abundant pycnia April 26, and aecia May 2. Similar material on *Carex riparia* from Iowa gave the same results in 1902.[10]

4. PUCCINIA ANGUSTATA Peck.—Teliosporic material on *Scirpus atrovirens* Muhl., from the vicinity of Lafayette, Ind., brought in by Mr. Frank Vasku, was sown on *Lycopus Americanus* April 22, giving rise to pycnia April 29, and aecia May 7.[11]

5. PUCCINIA FRAXINATA (Schw.) Arth.—A collection made in November, 1906, on *Spartina cynosuroides* Willd., at Red Cloud, Neb., by Rev. J. M. Bates, was sown on *Fraxinus lanceolata* May 11, giving rise to pycnia May 18. The same collector sent similar material from Grand Island, Neb., in March, 1907, which was sown on *Fraxinus lanceolata* May 25, giving rise to pycnia May 30, and aecia June 13. A like collection taken in April, 1907, similarly sown May 8, gave pycnia May 17. These sowings were all made on cut branches placed in water, which accounts for the slow development and early termination of growth.[12]

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[9] For previous cultures see Jour. Myc. *8*:54. 1902; Bot. Gaz. *35*:15. 1903.

[10] For previous cultures see Bot. Gaz. *20*:270. 1900; *35*:16. 1903; Jour. Myc. *8*:52. 1902; *12*:15. 1906.

[11] For previous cultures see Bot. Gaz. *29*:273. 1900; Jour. Myc. *8*:53. 1902; and *13*:196. 1907.

[12] For previous cultures see Bot. Gaz. *29*:275. 1900; Jour. Myc. *11*:57. 1905; and *12*:16. 1906.

6. PUCCINIA SUBNITENS Diet.—Teliosporic material on *Distichlis spicata* (L.) Greene was sent by Rev. J. M. Bates, from Red Cloud, Neb., and sown as follows:

April 10 on *Chenopodium album;* April 19, pycnia; April 23, aecia.
April 10 on *Bursa Bursa-pastoris;* April 26, pycnia; May 1, aecia.
April 10 on *Sarcobatus vermiculatus;* no infection.
April 17 on *Chenopodium album;* April 28, pycnia; May 1, aecia.
April 17 on *Sarcobatus vermiculatus* (two plants); no infection.
April 25 on *Chenopodium album;* May 6, pycenia; May 8, aecia.
April 25 on *Sarcobatus vermiculatus;* no infection.

Another collection of the rust on the same host, obtained by the writer at Ogallala, Neb., was sown on *Chenopodium album* April 29, giving rise to pycnia May 9, and aecia May 13. A sowing at the same time on *Sarcobatus vermiculatus,* and again on two plants June 1, gave no inefction. It may be definitely concluded that this species of rust as it exists in Nebraska is not transferable to *Sarcobatus vermiculatus.*[13]

7. PUCCINIA AMPHIGENA Diet.—Teliosporic material on *Calamovilfa longifolia* (Hook.) Hack., collected at Burnett, Neb., by Rev. J. M. Bates, was sown on *Smilax hispida* May 2, giving rise to pycnia May 9, and aecia May 16.[14]

8. PUCCINIA PHRAGMITIS (Schum.) Körn.—Teliosporic material on *Phragmites communis* Trin., collected at Scotia Junction, Neb., by Rev. J. M. Bates, was sown on *Rumex crispus* May 1, giving rise to pycnia (date not noted) and aecia May 17.[15]

9. PUCCINIA SIMILLIMA *Arth.*—Teliosporic material on *Phragmitis communis* Trin., collected at Scotia Junction, Neb., by Rev. J. M. Bates, was sown on *Rumex crispus,* with no infection, being mistaken for the previously mentioned species. Later it was sown on two plants of *Anemone Virginiana,* still with no infection. It was then sown on *Anemone Canadensis* June 3, giving rise to abundant pycnia June 11, and aecia June 19. This is a confirmation of the restricted range of aecial host, only one species of Anemone yet being found that can be infected.[16]

10. PUCCINIA AGROPYRI Ellis & Ev.—This is a very common rust of the Rocky mountain region. No culture of it has ever been tried in this country, but a collection made at Bozen, in the Austrian Tyrol, was successfully sown on *Clematis Vitalba,*

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[13] For previous cultures see Bot. Gaz. *35*:19. 1903; Jour. Myc. *11*:54. 1905; *12*:16. 1906; and *13*:197. 1907.

[14] For previous cultures see Bot. Gaz. *35*:20. 1903; Jour. Myc. *11*:57. 1905; and *12*:16. 1906.

[15] For previous cultures see Bot. Gaz. *29*:269. 1900; and Jour. Myc. *9*:220. 1903.

[16] For previous cultures see Bot. Gaz. *35*:20. 1903.

by Dr. P. Dietel in 1892.[17] While in the foothills of Colorado this spring Mr. F. D. Kern and the writer observed a plant of *Clematis ligusticifolia* with pycnia just starting, which was growing in the midst of some species of *Agropyron* heavily coated with the wintered telia of *Puccinia Agropyri.* Material was collected for cultures. The host was not in fruit, but is believed to be *A. pseudorepens* S. & S. Sowing of the spores was made on *Viorna Scottii* May 2, sparingly giving rise to pycnia May 15, but failing to develop aecia. A sowing was made May 10 on Clematis Virginiana, no plants of *C. ligusticifolia* being available, which gave rise to abundant pycnia May 20, and aecia May 27. This confirms the work by Dr. Dietel, and establishes the identity of the European and American form of the rust, which heretofore rested upon purely morphological grounds. This also shows that *Clematis Virginiana* may be a host for the species, although all collections so far reported on this host pretty certainly belong to the *Bromus* rust, *Puccinia tomipara* Trel.

11. PUCCINIA POCULIFORMIS (Jacq.) Wettst.— Teliosporic material on an undetermined species of *Agropyron,* obtained at Lake Forest, Ill., by Mr. F. D. Kern and the writer, was sown May 17 on *Berberis vulgaris,* showing pycnia May 27, and aecia June 5. Another collection on *Agropyron tenerum* Vasey, and from Scotia Junction, Neb., by Rev. J. M. Bates, was sown in like manner April 24, showing pycnia May 3, and aecia May 14. Aeciospores from the latter culture were sown on *Avena sativa* May 25, giving rise to uredinia June 7.[18]

12. PUCCINIA PAMMELII (Trel.) Arth.—Teliosporic material on *Panicum virgatum* L., Collected at Red Cloud, Neb., by Rev. J. M. Bates, was sown on *Euphorbia corollata,* with no infection, and later was sown on *E. marginata* May 31, giving rise to pycnia June 6, and aecia June 12. [19]

A number of attempts have been made to grow the teliospores of this rust upon *Euphorbia marginata,* but heretofore without success. In these cases the material was collected in Indiana, where *E. marginata* does not occur, but *E. corollata* is common and abundant. The material used this season gives the reverse condition: it was collected in Nebraska, where *E. corollata* does not occur or is rare, but *E. marginata* is conspicuously abundant. From cultures so far attempted there is reason to think that we have to do with physiological species. Whether any morphological distinctions exist is yet uncertain, but none has yet been detected.

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[17] Dietel, Ueber den Generationswechsel von Puccinia Agropvri Ell. et Ev.—Oesterr. bot. Zeitschrift *42*:261. 1892.

[18] For previous cultures see Jour. Myc. *8*:53. 1902; *11*:57. 1905; *12*:17. 1906; and *13*:198. 1907.

[19] For previous cultures see Proc. Ind. Acad. Sci. for *1901*:284. 1902; Jour. Myc. *11*:56. 1905; *12*:16. 1906.

13. UROMYCES ACUMINATA Arth.— Teliosporic material on *Spartina cynosuroides* Willd., collected at St. Paul, Neb., by Rev. J. M. Bates, was sown twice on thrifty plants of Lysimachia quadrifolia, with no infection. It was sown on *Steironema ciliata* May 14, giving rise to strongly developed pycnia May 22, and aecia May 27; while a second sowing May 30, gave pycnia June 6, and aecia June 11.[20]

These results confirm the studies of previous seasons, showing that the rust called by this name in different sections of the country should be segregated into distinct species, or else into physiological species. More observations and material for cultures are required from all parts of the region east of the Mississippi river.

14. UROMYCES SCIRPI (Cast.) Burr.— Teliosporic material on *Scirpus fluviatilis* (Torr.) A. Gray, collected at St. Paul, Neb., by Rev. J. M. Bates, was sown on *Oxypolis rigidus,* with no infection. It was sown on *Cicuta maculata* May 3, giving rise to abundant pycnia May 13, and aecia May 20, thus confirming the work of last season.[21]

15. UROMYCES SILPHI (Syd.) Arth.— Teliosporic material on *Juncus tenuis* Willd., collected at Red Cloud, Neb., by Rev. J. M. Bates, was sown on *Silphium perfoliatum* April 23, giving rise to pycnia May 4, and aecia May 11. Similar material sent by the same collector from Grand Island, Neb., was sown on another plant of the same host May 31, giving rise as before to pycnia June 12, and aecia June 17. These results well confirm the work of last year.[22]

16. PHRAGMIDIUM SPECIOSUM Fr.— Teliosporic material on *Rosa pratincola* Green (same as previously reported under the name *R. Arkansana*), collected in a meadow at Eldorado Springs (Boulder county), oClo., by the writer, was sown on *Rosa pratincola* May 20, giving rise to pycnia May 27, and aecia June 1.[23]

17. GYMNOSPORANGIUM JUNIPERI - VIRGINIANAE *Schw.*— Teliosporic material on *Juniperus Virginiana* L., collected at Dayton, Ind., by Mr. F. D. Kern, was sown on *Crataegus punctata,* with no infection, and on a cultivated apple, *Malus Malus,*

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[20] For previous successful and unsuccessful cultures see Jour. Myc. *12*:24. 1906; *13*:193. 1907.

[21] For previous cultures and discussion see Jour. Myc. *13*:199. 1907.

[22] For previous cultures see Jour. Myc. *13*:202. 1907.

[23] For previous cultures see Bot. Gaz. *35*:17. 1903; Jour. Myc. *11*:53. 1905.

April 12, giving rise to abundant pycnia April 24, but injury to the leaves prevented formation of acia.[24]

18. GYMNOSPORANGIUM GLOBOSOM Farl.— Teliosporic material collected as in the previous instance was sown on the Wealthy variety of *Malus Malus* April 12, giving rise to a few pycnia April 30, and afterward to aecia first observed July 12, although appearing much eralier.[25]

19. GYMNOSPORANGIUM NELSONI Arth.— Teliosporic material on *Juniperus scopulorum* Sarg., collected at Boulder, Colo., by E. Bethel, was sown on *Amelanchier intermedia* Spach (*A. Botryapium* DC., as given in Britton & Brown's Illustrated Flora), April 16, giving rise to pycnia April 25, but further development stopped by injury to leaves.

Another collection made at the same place two weeks later by Mr. F. D. Kern was sown on *A. Canadensis* (L.) Medic. (plant from the Arnold Arboretum), April 30, giving rise to pycnia May 8, and aecia May 29. Another sowing was made on another plant of the same sort May 15, which gave a great abundance of pycnia May 22, and a fine development of aecia a month later, June 24. The above cultures were on leaves only. The same material was now sown on both leaves and fruit of *Amelanchier erecta* Blanch. (plants received from Edw. Gillett, of Southwick, Mass., under name of *A. Canadensis,* but identified by Mr. W. H. Blanchard as typical *A. erecta*), May 13, and gave pycnia on upwards of thirty fruits and many leaves May 20, and the first aecia June 5, reaching full and normal maturity June 24. Another sowing was made on leaves of *Sorbus Americana* May 15, which gave rise to pycnia in fair amount May 21, and normally formed aecia, especially on the rachis and midribs, June 24.

The above results confirm and much extend the somewhat uncertain work of last season.[26] It leaves no further doubt that Roestelia Nelsoni Arth. should be counted a synonym of G. Nelsoni Arth., as suggested in the original publication of the name.

20. GYMNOSPORANGIUM CLAVIPES C. & P.—Teliosporic material on *Juniperus Sibirica* Burgsd., obtained at Lake Forest, Ill., by Mr. F. D. Kern, was sown on leaves of *Amelanchier intermedia* April 10, giving rise to a few pycnia May 1, but without maturing aecia. Another sowing was made on fruit of *A. erecta,* also giving rise to a few pycnia June 5, but not maturing aecia. Checking of development was doubtless due in both instances to inherent weakness of the hosts. A sowing was made on *Malus coronaria* and *Cataegus* sp., with no infection.

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[24] For previous cultures see Jour. Myc. *12*:13. 1906; *13*:200. 1907.

[25] For previous cultures see Proc. Am| Acad. Sci. *22*:263. 1887; Bot. Gaz. *14*:167. 1889; Jour. Myc. *13*200. 1907.

[26] See Jour. Myc. *13*:203. 1907.

Cultures of this species were made by. Prof. W. G. Farlow,[27] in 1883, from teliosporic material on *Juniperus Virginiana,* which gave rise to pycnia on leaves of *Malus Malus, Aronia arbutifolia* and *Amelanchier Canadensis,* but failed to mature aecia. Cultures were also made by Dr. Roland Thaxter[28] in 1886, from similar material, producing pycnia on leaves of *Malus Malus.* and both pycnia and well developed aecia on *Amelanchier Canadensis,* especially on stems and midrifs. A difference in the source of material used in the earlier cultures, and for the present year, is worth noting. The former was taken from *Jumperus Virginiana,* the red cedar, while the latter came from *Juniperus Sibirica,* the dwarf juniper. This is the only species of *Gymnosporangium* so far known to inhabit both the true cedars and the true junipers, and the situation should receive careful study. Either the species is a more generalized one than usual, which is not borne out by the geographical distribution, or it is an aggregate of two closely related forms thus far confused.

21. GYMMOSPORANGIUM CLAVARIAEFORME (Jacq.) DC.—Teliosporic material on the stems of *Juniperus Sibirica* Burgsd., obtained at Lake Forest, Ill., by Mr. F. D. Kern, was sown on leaves of *Malus Malus* (Bechtel Crab variety), with no infection, and also on leaves of *Amelanchier intermedia* April 11, giving rise to a few pycnia April 20, but to no further development owing to withering of the leaves.

The first culture of this species was made in Denmark, by Oersted, in 1867. The numerous subsequent cultures by European investigators are summarized by Klebahn.[29] The only definite cultures with American material were made by Dr. Roland Thaxter,[30] in 1886 and 1887. He grew an abundance of pycnia and aecia on *Crataegus tomentosa* and *Amelanchier Canadensis.* Uncertain results were obtained in trials by Prof. L. H. Pammel.[31]

22. GYMNASPORANGIUM NIDUS-AVIS Thax.—Teliosporic material on *Juniperus Virginiana* L., obtained at Lake Forest, Ill., by Mr. F. D. Kern, was sown on *Amelanchier intermedia,* with no infection, and also on *Malus Malus* (Whitney Crab variety April 10, which gave rise to a few pycnia April 17, and aecia May 11, a period of incubation shorter than for most Gymnosporangia. The spores for sowing were taken from large sori on the branches. The only previous cultures of this species were made by Dr.

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[27] Proc. Am. Acad. Sci. *20*:313. 1885.

[28] Bot. Gaz. *11*:236. 1886; Proc. Am. Acad. Sci. *22*:264. 1887.

[29] Die wirtswechselnden Rostpilze, pages 339-345.

[30] Proc. Am. Acad. Sci. *22*:262. 1887; and Bot. Gaz. *14*:166. 1889.

[31] Bull. Iowa Exper. Sta. *84*:33. 1905.

Roland Thaxter,[32] in an extensive series running from 1886 to 1890, inclusive. He grew it on *Amelanchier Canadensis* in great abundance, showing both pycnia and aecia, and in one instance pycnia were formed on the common apple, but failed to develop further. Thaxter also noted the early development of pycnia and aecia.

The following eight species have now been grown in cultures for the first time, so far as the writer knows. The two cases of amphispores and the one autoecious species resulted as anyone might have taken for granted, but in the other five cases the results are wholly unpredicted, and represent very material advancement in the knowledge of American heteroecious rusts.

1. PUCCINIA VEXANS Farl.—Material bearing both teliospores and amphispores on *Atheropogon curtipendulus* (Michx.) Fourn. (*Bouteloua racemosa* Lag.), was sent from Boulder, Colo., by Mr. E. Bethel, and gave good germination for the amphispores, but the teliospores refused to grow. Sowing was made on *Atheropogon curtipendulus* May 29, and uredinia were observed June 21, although they may have appeared earlier and been overlooked. The amphispores were the characteristic, dark-colored, thick-walled and four-pored form, while the urediniospores, to which they gave rise, had the usual light-colored, thin-walled anr eight-pored appearance. The difference between the resting form (amphispore) and active form of the urediniospores belonging to this species is very striking. This is the second time, as far as the writer knows, that amphispores of this species have been seen to germinate.

2. PUCCINIA CRYPTANDRI Ellis & Barth.—Amphisporic material on *Sporobolus cryptandrus* (Torr.) A. Gray, obtained at Manitou, Colo., by Mr. F. D. Kern and the writer, was sown on a plant of the same species of grass May 9, and uredinia appeared May 24. In this case the difference between the resting or amphisporic form of the urediniospores and the active or summer form is not so marked as in the preceding species, and yet there is no mistaking one for the other.

3. PUCCINIA OBTECTA Peck.—Teliosporic material on *Scirpus Americanus* Pers., obtained near Lafayette, Ind., by Mr. F. D. Kern, was sown on *Urtica gracilis,* and *Silphium perfoliatum,* with no infection, and afterward on *Bidens frondosa* June 5, giving rise to a few pycnia June 19, and aecia first noticed July 6, but probably opening earlier. Another sowing was made on *B. frondosa* and also on *B. connata* June 24, both showing a good devedopment of pycnia July 1, and aecia July 6.

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[32] Bot. Gaz. *11*:238. 1886; Proc. Am. Acad. Sci. *22*:264. 1887; Bot. Gaz. *14*:167. 1889; and Bull. Conn. Exper. Sta. *107*:5. 1891.

The telial stage is common and well known throughout the United States and extending into Mexico, but the aecial stage has rarely been collected. Collections of aecia are in the writer's harbarium from Nebraska and Wisconsin, and in the literature one is also recorded from Illinois. On the basis of a single collection on *Bidens frondosa* Professor Burrill separated it as a special form, and De Toni, in the seventh volume of Saccardo's Sylloge, supplied the name *Aecidium compositarum* var. *Bidentis* Burrill.

4. PUCCINIA on CAREX STENOPHYLLA.—Teliosporic material of this rust collected at Boulder, Colo., by the writer, was sown on *Solidago Canadensis* and *Baptisia leucantha*, with no infection.

It was at this point in the work that a brief note of observation was seen in Dr. W. Tranzschel's second report on "Beiträge zur Biologie der Uredineen." This is a translation in full: "In July, 1900, I found in Turkestan, near Irkeschtam on the Chinese border, the *Aecidium Dracunculi* Thüm. on *Artemisia Dracunculus* in great abundance. Associated with the affected Artemisia grew *Carex stenophylla* Wahlb., on which was found uredosori." Accepting this as a hint, the Colorado material was now sown on *Artemisia dracunculoides*. As no potted plant was available, a sowing was made in the open, giving no infection, and another in the greenhouse on a cutting placed in water. The latter attempt gave very abundant and unequivocal results. The sowing was made May 31, and pycnia appeared June 6, followed by aecia June 15, both numerous and finely developed.

The type collection of this Aecidium was made in Siberia, at Minussinsk, also on the Chinese border, but about a thousand miles northeast of the locality where it was found by Dr. Tranzschel. This collection was distributed in Thuemen's Mycotheca Universalis, No. 1223. A collection of aecia on *Artemisia dracunculoides* from Nebraska was distributed in Ellis & Everhart's Fungi Columbiani, No 1664. A careful comparison shows no apparent difference between the Asian and American collections, and the two are accepted as the same species.

As a name and description seem to be demanded for this species, the following are submitted:

**Puccinia universalis nom. nov.** (**Aecidium Dracunculi** Thuem., not **Puccinia Dracunculi** Auers.)

O. Pycnia chiefly epiphyllous, numerous in orbicular groups, punctiform, honey-yellow, rather inconspicuous; subepidermal, slightly depressed-globose, 100-160 μ broad by 90-112 μ high; ostiolar filaments 40-80 μ long.

I. Aecia chiefly hypophyllous, crowded in orbicular groups opposite the pycnia, 1-3 mm. across, peridia cylindrical, 0.5 mm. high, margin usually erect, erose, peridial cells rhomboidal, 20-30 μ long, overlapping, inner wall medium thick, 3-4 μ, verrucose, outer wall thicker, 5-9 μ, smooth, striate; aeciospores globoid, small, 12-18 by 15-21 μ; wall very thin, 0.5-1μ, nearly colorless, very minutely granular.

On *Artemisia dracunculoides* Pursh, Colorado, Nebraska; *A. Canadensis* Michx., Iowa, Nebraska; *A. frigidia* Willd., Montana; *A. kansana* Britt., Nebraska. Type on *A. Dracunculus* L., Western Siberia.

II. Uredinia epiphyllous, scattered, oblong, 0.2-0.5 mm. long, rather early naked, cinnamon-brown, ruptured epidermis conspicuous; urediniospores broadly ellipsoid, 15-19 by 20-26 μ, wall cinnamon brown, 1-1.5 μ thick, rather finely echinulate, pores 2, equatorial.

III. Telia epiphyllous, scattered, roundish or oblong, 0.1-0.3 mm. wide by 0.2-1.2 mm. long, early naked, pulvinate, ruptured epidermis noticeable; teliospores clavate-oblong, 16-26 by 35-52 μ, wall dark chestnut-brown, lighter and about 1.5-2 μ thick below, thicker above, 7-12 μ, smooth; pedicel tinted, one-half length of spore, or more.

On *Carex stenophylla* Wahl., Colorado, Nebraska, Montana.

5. PUCCINIA on CAREX LONGIROSTRIS.—Field observations by Dr. E. W. Olive, and material furnished by him, including aecia host plants, supplied the entire basis for the result reported under this number.

Teliospores from *Carex longirostris* Torr. were sown June 4 on *Aster paniculatus, Erigeron annuns, Solidago Canadensis, Ribes Cynosbati,* and *Phryma leptostachya,* with no infection, except on Phryma, which showed pycnia June 10 in great abundance, and aecia June 15. The development was exceptionally strong and characteristic.

No rust has heretofore been reported on this species of Carex. The aecial stage was first collected at Spirit Lake, Iowa, by Dr. B. D. Halsted, in 1886, and has since been reported from Minnesota and Nebraska, and found by Dr. Olive this season at Madison, Wis. A description of the species in its several spore-stages is appended:

**Puccinia Phrymae (Halst.) nom. nov. (Aecidium Phrymae** Halst., Jour. Myc. **2**:52. 1886.)

O. Pycnia amphigenous, few, crowded in small groups, inconspicuous, honey-yellow, becoming blackish-brown, slightly flattened globoid, 77-110 μ in diameter by 65-80 μ high; ostiolar filaments 40-50 μ long.

I. Aecia hypophyllous, gregarious, in large open groups on discolored spots 4-10 mm. across, very short, 0.2-0.3 mm. in diameter, pale yellow; peridia colorless, margin recurved, erose, peridial cells rhomboidal in longitudinal section, overlapping, inner wall thin, about 1 μ, finely verrucose, outer wall thicker, 3-4 μ, striate, smooth; aeciospores globoid, 12-16 by 14-19 μ, wall pale yellow, thin, 1 μ or less, finely verrucose.

On *Phryma leptostachya* L., Iowa, Wisconsin, Nebraska, Minnesota. Type from Spirit Lake, Iowa.

II. Uredinia hypophyllous, scattered, round or oblong, early naked, ruptured epidermis noticeable; urediniospores broadly ellipsoid, 15-18 by 18-20 μ, wall cinnamon-brown, 1-1.5 μ thick, finely and rather sparsely echinulate, pores 2, in upper part.

III. Telia hypophyllous, scattered, round or oblong, 0.2-0.4 mm. wide by 0.3-0.8 mm. long, early naked, dark chocolate-brown, pulvinate, ruptured epidermis noticeable; teliospores clavate-oblong, 12-15 by 35-45 $\mu$, rounded or obtuse at apex, usually narrowed below, wall chestnut-brown, concolorous, 1-1.5 $\mu$ thick, much thicker, 9-13 $\mu$: pedicel about length of spore or less, tinted.

On *Carex longirostris* Torr., Wisconsin.

6. PUCCINIA MUTABILIS Ellis & Gall.—While collecting for a few days in Colorado about the first of May, wintered-over teliospores were found on a number of species of Allium, in most cases not accurately determined for want of the inflorescence. In a few cases young leaves of the season showed freshly formed uredinia, and in one instance immature telia were observed beside the uredinia, evidently arising from the same mycelium. A few very young aecia, well isolated from other spore forms were also found. As it was clearly too early in the season to have had aecia mature and reinfect the host, and in this manner give rise to the uredinia, the question arose whether the aecia did not belong to some heteroecious species, while the uredinia and telia represented a species without aecia. Further search in the field brought to light some leaves which without question had remained alive over winter. In one case the dead tip of such a leaf bore telia of last year's growth, and on the adjoining green part of the leaf uredinia were forming. This seemed to show that the early uredinia were derived from wintered-over mycelium, but it left the question of the origin of the aecia unsolved.

Teliosporic material on what was believed to be *Allium reticulatum* Fraser, was obtained by the writer at Eldorado Springs, Colo., and sown on *Allium recurvatum* Rydb., May 18, giving rise to pycnia June 3, and aecia June 7. The life cycle of the rust with all spore forms is therefore established, although it is clearly possible in exceptional cases for the mycelium to be carried over the winter in leaves that retain their vitality and thus start the rust in the spring at the uredinial stage.

7. GYMNOSPORANGIUM BETHELI Kern.—Teliosporic material or *Juniperus scopulorum* Sarg., obtained at Boulder, Colo., by Mr. F. D. Kern, was sown on *Crataegus* sp. (received from the Arnold Arboretum) April 30, showing pycenia May 8, and aecia June 5, the aecia being fully matured by June 17. Another sowing was made on *Crataegus coccinea* May 15, showing pycnia May 21, and aecia June 24. Another sowing on *Crataegus punctata* May 15, gave pycnia May 21, but the leaves withered before aecia had formed. Another sowing on *Sorbus Americana* May 21, gave rise to numerous pycnia May 29, and an equal abundance of well formed aecia July 25.

Similar material obtained at Wolcott, about one hundred miles west of Boulder, was sown on *Crataegus cordata* (Mill.) Ait. May 5, on a tree out of doors, giving rise to pycnia May 17, and aecia July 1. Another sowing on *Sorbus Americana* May 15, gave a large number of pycnia May 24, and aecia well formed July 25. A sowing on *Amelanchier erecta* gave no infection.

All the foregoing sowings were on the leaves. The ample success attained admits of no question that the aecia, recently described under the name *Roestelia Betheli* Kern, do in fact belong to the large gall form of cedar rust, as suggested by Mr. E. Bethel[33] from field observations.

8. GYMNOSPORANGIUM INCONSPICUUM Kern. — Teliosporic material on *Juniperus Utahensis* (Engelm.) Lemmon, obtained from the type locality at Glenwood Springs, Colo., by Mr. F. D. Kern and the writer, was sown on the leaves of *Crataegus* sp., *Amelanchier Canadensis,* and *Pyrus communis,* with no infection. It was afterward sown on fruit of *Amelanchier erecta* May 10, which gave rise to abundance of pycnia May 24, and aecia June 15, the aecia being mature by June 19. The affected areas of the fruit became somewhat swollen, and of a yellowish white color, making them conspicuous. The aecia prove to be identical with *Roestelia Harknessianoides* Kern, and thus confirm the inference drawn from fiield observations.[34]. It is an interesting fact that while the telia of this species of rust are very evanescent, the aecia persist and may be found on mummified fruits the year following infection, so that it is likely to become common in herbaria.

## SUMMARY.

The following is a complete list of successful cultures made during the season of 907. It is divided into two series: species previously reported by the writer or other investigators, and species now reported for the first time.

### *A Species previously reported.*

1. PUCCINIA ALBIPERIDIA Arth. — Teliospores on *Carex* crinita Lam., sown on *Ribes Cynosbati* L.

2. PUCCINIA CARICIS-ASTERIS Arth. — Teliospores on *Carex rosea* Schk., sown on *Aster cordifolia* L., and on *Carex* sp., sown on *Aster paniculatus* Lam.

3. PUCCINIA CARICIS (Schum.) Reb. — Teliospores on *Carex stipata* Muhl., and on *C. riparia* Curt., sown on *Urtica gracilis* Ait.

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[33] Bull. Torrey Club *34*:460. 1907.
[34] Bull. Torrey Club *34*:463. 1907.

4. PUCCINIA ANGUSTATA Peck. — Teliospores on *Scirpus atrovirens* Muhl., sown on *Lycopus Americanus* Muhl.

5. PUCCINIA FRAXINATA (Schw.) Arth. — Teliospores on *Spartina cynosuroides* Willd.,sown on *Fraxinus lanceolata* Borck.

6. PUCCINIA SUBNITENS Diet. — Teliospores on *Distichlis spicata* (L.) Greene, sown on *Chenopodium album* L., and *Bursa Bursa-pastoris* (L.) Britt.

7. PUCCINIA AMPHIGENA Diet. — Teliospores on *Calamovilfa longifolia* (Hook) Hack., sown on *Smilax hispida* Muhl.

8. PUCCINIA PHRAGMITIS (Schum.) Körn. — Teliospores on *Phragmites communis* Trin., sown on *Rumex crispus* L.

9. PUCCINIA SIMILLIMA Arth. — Teliospores on *Pharagmites communis* Trin., sown on *Anemone Canadensis* L.

10. PUCCINIA AGROPYRI Ellis and Ev. — Teliospores on *Agropyron pseudorepens* S. & S., sown on *Viorna Scottii* (Porter) Rydb., and on *Clematis Virginiana* L.

11. PUCCINIA POCULIFORMIS (Jacq.) Wettst. — Teliospores on *Agropyron tenerum* Vasey, sown on *Berberis vulgaris* L., and aeciospores from this culture sown on *Avena sativa* L.

12. PUCCINIA PAMMELII (Trel.) Arth. — Teliospores on *Panicum virgatum* L., sown on *Euphorbia marginata* Pursh.

13. UROMYCES ACUMINATUS Arth. — Teliospores on *Spartina cynosuroides* Willd., sown on *Steironema ciliata* (L.) Raf.

14. UROMYCES SCIRPI (Cast.) Burr.— Teliospores on *Scirpus fluviatilis* (Torr.) A. Gray, sown on *Cicuta maculata* L.

15. UROMYCES SILPHII (Syd.) Arth.— Teliospores on *Juncus tenuis* Willd., sown on *Silphium perfoliatum* L.

16. PHRAGMIDIUM SPECIOSUM Fr.— Teliospores on *Rosa pratincola* Greene, sown on same host.

17. GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE Schw. — Teliospores on *Juniperus Virginiana* L., sown on *Malus Malus* (L.) Britt.

18. GYMNOSPORANGIUM GLOBOSUM Farl. — Teliospores on *Juniperus Virginiana* L., sown on *Malus Malus* (L.) Britt.

19. GYMNOSPORANGIUM NELSONI Arth. — Teliospores on *Juniperus Scopulorum* Sarg., sown on *Amelanchier intermedia* Spach, *A. Canadensis* (L.) Medic., *A. erecta* Blanch., and *Sorbus Americana* Marsh.

20. GYMNOSPORANGIUM CLAVIPES C. & P.—Teliospores on *Juniperus Sibirica* Burgsd., sown on *Amelanchier intermedia* Spach, and *A. erecta* Blanch.

21. GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) DC.—Teliospores on *Juniperus Sibirica* Burgsd., sown on *Amelanchier intermedia* Spach.

22. GYMNOSPORANGIUM NIDUS-AVIS Thax.—Teliospores on *Juniperus Virginiana* L., sown on *Malus Malus* (L.) Britt.

*B. Species reported now for the first time.*

1. PUCCINIA VEXANS Farl.— Amphispores on *Atheropogon curtipendulus* (Michx.) Fourn., sown on same host.

2. PUCCINIA CRYPTANDRI Ellis & Barth.— Amphispores on *Sporobolus cryptandrus* (Torr.) A. Gray, sown on same host.

3. PUCCINIA OBTECTA Peck.—Teliospores on *Scirpus Americanus* Pers., sown on *Bidens frondosa* L., and *B. connata* Muhl.

4. PUCCINIA UNIVERSALIS Arth.— Teliospores on *Carex stenophylla* Wahl., sown on *Artemisia dracunculoides* Pursh.

5. PUCCINIA PHRYMAE (Halst.) Arth.—Teliospores on *Carex longirostris* Torr., sown on *Phryma leptostachya* L.

6. PUCCINIA MUTABILIS Ellis & Gall.— Teliospores on *Allium reticulatum* Fraser, sown on *A. recurvatum* Rydb.

7. GYMNOSPORANGIUM BETHELI Kern.—Teliospores on *Juniperus scopulorum* Sarg., sown on *Crataegus coccinea* L., *C. punctata* Jacq., *C. cordata* (Mill.) Ait., and *Sorbus American* Marsh.

8. GYMNOSPORANGIUM INCONSPICUUM Kern.— Teliospores on *Juniperus Utahensis* (Engelm.) Lemmon, sown on *Amelanchier erecta* Blanch.